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(54) Title: A METHOD AND A SYSTEM FOR ACTIVITY SUPERVISION IN A MOBILE TELEPHONE NETWORK

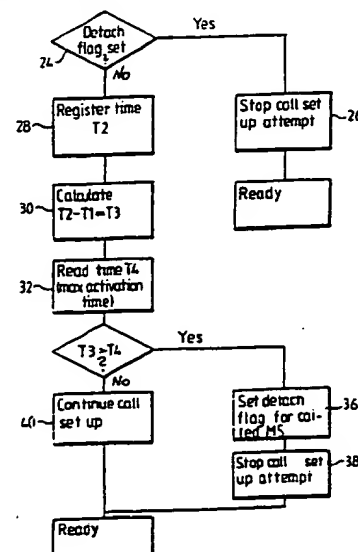
(57) Abstract

The invention relates to a method of determining in a mobile telephone network when a mobile can be considered to be switched-off, so as to obviate the need of paging the location of the mobile concerned upon the occurrence of a terminating call thereto. The time of making each radio contact with the mobile is recorded, and upon the occurrence of a terminating call, the difference between the time of this occurrence and the recorded time is calculated. The mobile is marked as being switched-off when this difference exceeds a given length of time.

Action at radio contact with GSM mobile station in MSC/VLR



Action at arrival of mobile terminated call in MSC/VLR



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A Method and a System for Activity Supervision
in a Mobile Telephone Network

5 Field of the invention

The present invention generally relates to cellular mobile radio systems based upon the so called GSM standard (GSM - Global System for Mobile communication), and more particularly to a method and to a system for determining in a
10 mobile telephone network when a mobile can be considered to be switched-off so as to obviate the need to page the mobile concerned upon occurrence of a terminating call.

Background of the invention

15 A GSM network basically comprises at least one base station system BSS including a base station controller BSC and base station transceivers BTS. The GSM network furthermore includes a mobile services switching centre MSC, a home location register HLR and a visitors location register VLR.

20 Each subscribing mobile station MS belongs to a HLR in a home network, wherein permanent subscriber data is stored. When a mobile station is registered in a MSC/VLR as a new visitor, that mobile station's HLR sends a copy of the relevant subscriber data to MSC/VLR.

25 Present-day mobile telephony systems have a finite available radio-path capacity, and consequently different methods are employed in an attempt to utilize available radio resources to a maximum.

When signalling to and from mobiles, it is necessary to
30 achieve uniform distribution between signalling from the network to the mobile and between signalling from the mobile to the network, in order to better utilize those radio resources that are available.

In order to make the area within which a called sub-
35 scriber shall be paged as small as possible when connecting a call to a mobile subscriber, the radio network is divided into location areas which consist of one or more cells. This results primarily in a reduction of the load on the radio path in a direction from network to mobile. Thus, only the
40 radio network is loaded in that location area in which the

paged mobile is expected to be located when paging, this being the procedure followed by the network when paging a called mobile. Consequently, procedures are found in which the mobiles are required to inform the network of a move from one location area to another and which oblige the mobiles to carry out this procedure. These procedures are called location updating procedures in the GSM-system.

It is not sufficient to know in which location area a given mobile is located, since the mobile may have switched-off its receiving power and cannot therefore be reached by paging. It is thus desirable to avoid paging a mobile when it is known that the mobile is not switched-on. This would avoid loading the radio network unnecessarily with signalling from network to mobile.

In order to ascertain in the network when the power of a mobile has been switched-off, there has been introduced into the GSM-system a procedure known as IMSI-detach. An IMSI-detach procedure involves a mobile informing the network that the power will be switched-off. The network now registers this information in the mobile telephone station concerned, MSC/VLR in GSM for the subscriber concerned. When the call is subsequently terminated, no further paging is carried out, therewith conserving radio capacity.

The IMSI-detach method, however, has certain weaknesses. Firstly, the message to the network from the mobile that the power has just been switched-off, i.e. implementing the IMSI-detach procedure, may be unsuccessful because the message fails to reach the network, for instance. The mobile may, furthermore, be located in a radio shadow which prevents the mobile from sending a message to the network. These weaknesses mean that subsequent paging attempts will always be unsuccessful and that the radio network may be loaded unnecessarily.

A highly important function of each MSC/VLR is therefore the so-called activity supervision procedure or implicit detach procedure. An implicit detach procedure is based on the assumption that the mobile is in all probability switched-off, despite the fact that no IMSI-detach message has been received in the network from the mobile.

The implicit detach procedure assumes that a mobile is no longer switched-on, when a certain length of time has passed since the last radio contact with that particular mobile. However, in turn, this method requires the mobile to inform
5 the network that it is switched-on after a given interval of time, even though the mobile has not moved to a new location area. Periodic location updating is specified in the GSM-recommendations.

In order for implicit detach to function correctly, the
10 periodic location updating periods must be shorter than the implicit detach periods, i.e. shorter than the time period after which a mobile is considered to be switched-off.

Implicit detach procedures have been implemented in earlier systems by allocating to each subscriber in the
15 MSC/VLR concerned a continuous time supervising or monitoring process which is restarted each time a radio contact is made with the mobile. The mobile is considered to be switched-off when this time monitoring period expires (time out), and accordingly no paging is carried out when terminating a call
20 established after time-out. The time period for this implicit detach procedure is set by the MSC-operator and may vary, for instance, between fifteen minutes and some hours.

The aforescribed solution results in a significant basic load on the system. This is because each individual
25 time supervision procedure requires processor power, and each subscriber to an MSC-system has a continuously operating time supervision procedure (with the exception of those subscribers that have already switched-off or are considered to have switched-off because the time supervising period has
30 expired). A MSC/VLR-system will have in excess of 100,000 registered subscribers at one and the same time.

Background art

GB 2,244,409 describes a mobile radio system in which the
35 mobiles are switched-on periodically with the intention of updating the capacity of the mobile at the base station. Each mobile has a timer which initiates periodic communication with the base station. The system is able to store items concerning the latest registration of a mobile, including the

time at which the latest registration was made and the time interval between consecutive registrations. The system is able to decide on this basis how messages to the mobile can be suitably delivered. Thus, it is possible to decide when it is possible to contact the mobile, with the aid of the time recordings.

EP 102,129 describes a radio communication system in which a mobile receiver is able to communicate with at least one transmitter. The transmitters transmit on several channels and the receiver includes a tuner which is able to scan the channels. Each transmitter transmits periodically a signal on its transmitter channel. The receiver includes a timer which activates the scanner when such a signal has not been received on the channel to which the receiver is set for a predetermined length of time which is not shorter than the time period of said channel signals, and for deactivating the scanner when such a signal is received on the channel to which the receiver is set.

20 Disclosure of the Invention

The object of the invention is to provide a method and a system which eliminates the aforesaid drawbacks and which are operative in determining that the time lapse since the latest radio contact is of such long duration that the mobile can be considered to be switched-off.

This object is achieved in accordance with the inventive method by the steps of

registering a time stamp T1 at which each radio contact is made with a mobile,
30 registering upon occurrence of a terminating call to a mobile station a time of occurrence T2,
calculating a time difference T3 between said time stamp T1 and said time of occurrence T2,
marking the called mobile station as being switched-off
35 if said time difference T3 exceeds a predetermined length of time T4.

The system according to the invention as included in a GSM mobile telephone network including mobile switching centers, comprises in said mobile switching centers

means for registering a time stamp T1 at which each radio contact is made with a mobile,

means for registering upon occurrence of a terminating call to a mobile station a time of occurrence T2,

5 means for calculating a time difference T3 between said time stamp T1 and said time of occurrence T2,

means for marking the called mobile station as being switched-off if said time difference T3 exceeds a predetermined length of time T4.

10 Thus, instead of constantly monitoring time with each subscriber, this monitoring function is achieved by recording the time of each radio contact with a mobile. This time stamp thus includes the time at which the latest radio contact was made.

15 Upon the occurrence of a terminating call, the difference between the terminating call and the time stamp of the called subscriber is then calculated. When the difference between these times exceeds the time set by the operator for the implicit detach procedure, the mobile is considered to be
20 switched-off. The mobile is then marked as being switched-off and paging is not carried out.

The invention provides a simple and robust mechanism for activity supervising, or implicit detach, procedures. The inventive implicit detach procedure also affords other
25 advantages over earlier detach solutions, such as lower development costs and savings in processor capacity.

Brief Description of the Drawing

The invention will now be described in more detail with
30 reference to the enclosed drawings, on which

Figure 1 is a schematic diagram illustrating the basic structure of a conventional GSM network,

Figure 2 schematically indicates the method according to the invention,

35 Figure 3 is a flowchart representation of the method according to the invention.

Description of a Preferred Embodiment

With reference to Figure 1, a GSM cellular network

basically comprises a number of base station systems, of which two are generally indicated at BSS1 and BSS2, respectively. Each of the base station systems BSS1 and BSS2 includes a base station controller BSC1 and BSC2, respectively, connected to base station trancellers BTS via communication links L, one of said base station trancellers being designated BTS.n in Figure 1. Each tranceller BTS is located in an associated cell of the cellular network, which is shown in Figure 1 as a honeycomb structure wherein each hexagone represents a cell. In Figure 1 the cell containing the tranceller BTS.n is designated C.n. The GSM network furthermore includes a mobile services switching centre MSC having a visitors location register VLR. There are furthermore one or more home location registers HLR communicating with the MSC. The MSC is connected for communication with the base station controllers BSC1 and BSC2 via a public land mobile network PLMN.

Although not shown, the MSC shown i Figure 1 usually has an interface to other MSCs, each MSC having furthermore interfaces for connection to a local public switched telephone network.

Each subscribing mobile station MS belongs to a HLR in a home network, wherein permanent subscriber data is stored. When a mobile station is registered in a MSC/VLR as a new visitor, that mobile station's HLR sends a copy of the relevant subscriber data to MSC/VLR.

Figure 2 illustrates in the form of a table 2 the content of a subscriber data register which is included in a mobile services switching center (MSC) shown two times at 4' and 4", respectively, for indicating two different occasions. A first column/memory location 6 in the table identifies subscribers 1-n. The time T1 at which radio contact is made with each subscriber is written into a second column/memory location 8, this marking hereinafter being referred to as the time stamp. This time stamp thus contains the time for the last radio contact with the subscriber in question. A third column/memory location 10 is intended to contain a marking with regard to each subscriber as to whether paging shall be carried out or whether a detach-marking has already been

effected, upon the occurrence of a terminating call. A fourth column/memory location 12 is intended for other subscriber data.

At 4' it is indicated by an arrow 14 how the time stamp
5 is written into the subscriber register 2 in location 8 in case of radio contact with a subscribing mobile station 9.

At 4" two measures are schematically indicated, viz. reading, c.f. arrow 16, of the subscriber time stamp T1 upon the occurrence of a subscriber terminating call, cf. arrow
10 18, to mobile station 9, as well as reading of the time T2 at which the terminating call was made, visualized with a clock 20. The difference T3 between these two points of time is calculated and a decision as to whether paging shall be carried out or whether a detach-marking shall be instigated
15 is decided on the difference calculated.

The above steps carried out in accordance with the present invention are summarized below with reference to Figure 3.

At each radio contact with a MS the subscriber data of
20 that particular subscriber are renewed with a new time stamp, i.e. a new contact time T1 is registered, step 22.

At arrival of a mobile terminated call in MSC/VLR a check is made in step 24 whether a detach marking has already been instigated. If the answer is YES, the call set up attempt is
25 stopped in step 26. If NO, the time T2 of this call is registered in step 28.

In step 30 the time difference $T2 - T1 = T3$, is calculated.

In step 32 a time T4 set by the operator of the MSC/VLR for the IMSI-detach procedure is read.

30 In step 34 it is calculated whether T3 exceeds T4. If the answer is YES, detach flag is set for the called MS in step 36, and call set up attempt is stopped in step 38. If the answer is NO, the call is continued in step 40.

The skilled person will be well aware of the software and
35 hardware required in the mobile services switching center to carry out the aforescribed functions, and such software and hardware need not therefore be described here.

Claims

1. A method of determining in a mobile telephone network when a mobile station can be considered to be switched-off so
5 as to obviate the need to page the mobile station concerned upon the occurrence of a terminating call thereto, comprising the steps of

registering a time stamp T1 at which each radio contact is made with a mobile,
10 registering upon occurrence of a terminating call to a mobile station a time of occurrence T2,
calculating a time difference T3 between said time stamp T1 and said time of occurrence T2,
marking the called mobile station as being switched-off
15 if said time difference T3 exceeds a predetermined length of time T4.

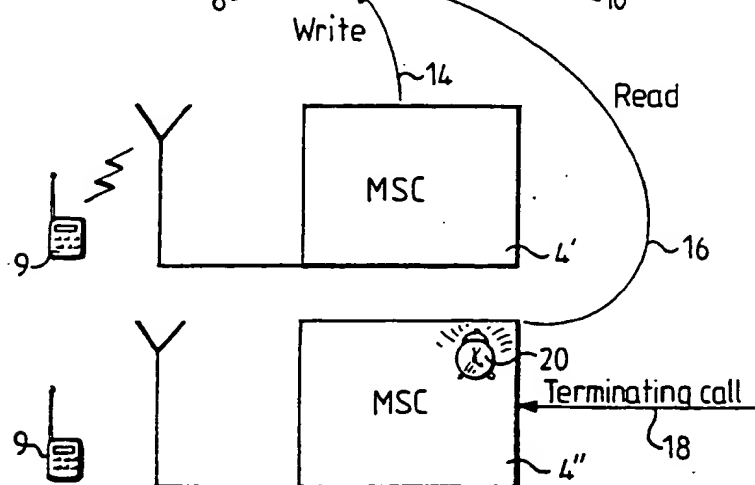
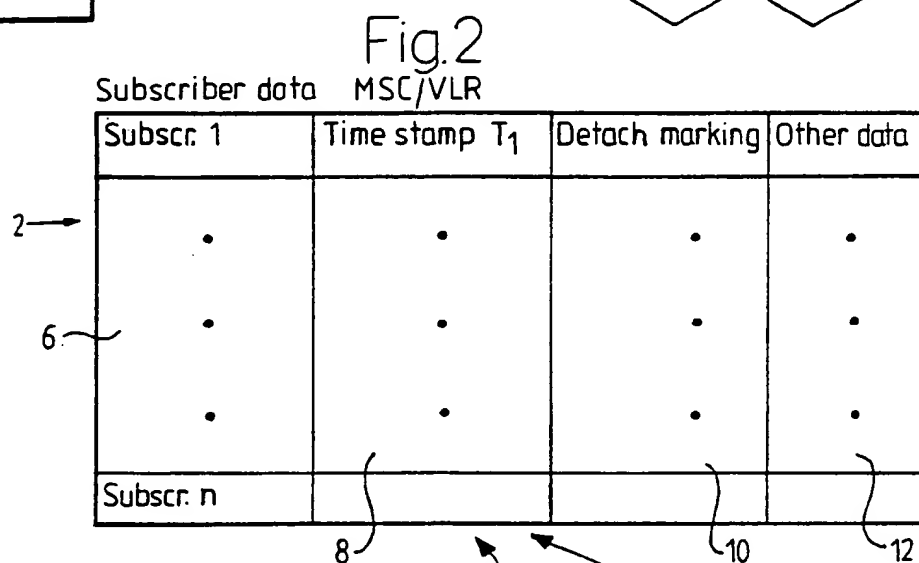
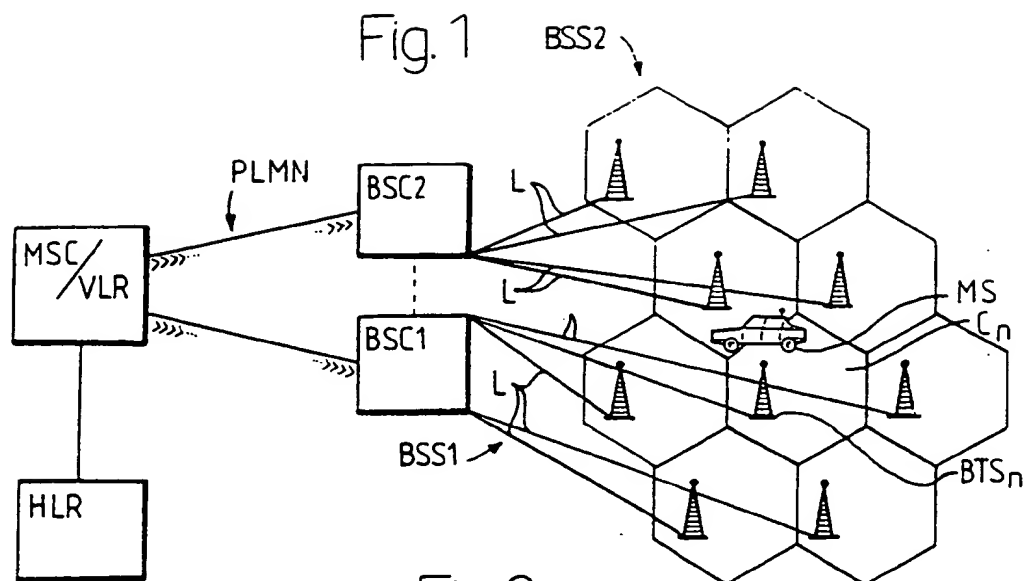
2. A method according to claim 1, comprising the step of first checking, at occurrence of a terminating call to a mobile station, whether said station has allready been marked
20 as being switched off, and stopping the call set up attempt if this is the case.

3. In a GSM mobile telephone network including mobile switching centers, a system for determining when a mobile station can be considered to be switched-off, so as to
25 obviate the need of paging the mobile station upon the occurrence of a terminating call thereto, said system comprising in said mobile switching centers

means for registering a time stamp T1 at which each radio contact is made with a mobile,
30 means for registering upon occurrence of a terminating call to a mobile station a time of occurrence T2,
means for calculating a time difference T3 between said time stamp T1 and said time of occurrence T2,
means for marking the called mobile station as being
35 switched-off if said time difference T3 exceeds a predetermined length of time T4.

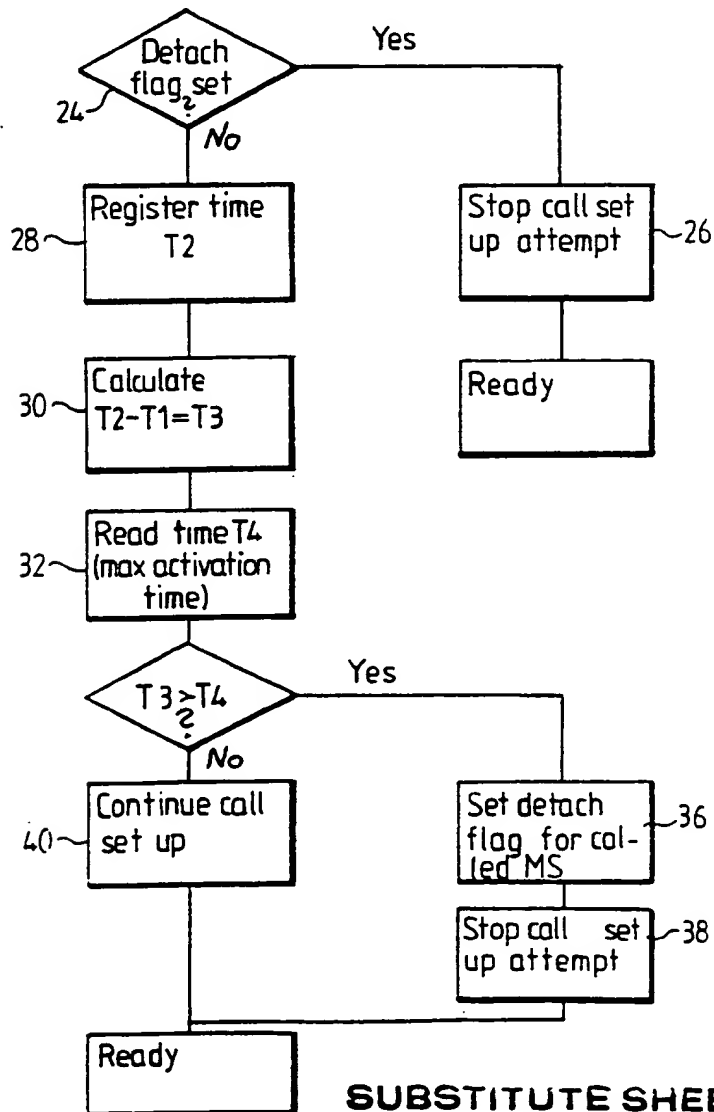
4. A system according to claim 3, comprising means for first checking, at occurrence of a terminating call to a mobile station, whether said station has allready been marked

as being switched off, and stopping the call set up attempt
if this is the case.



SUBSTITUTE SHEET

Fig. 3

Action at radio contact with GSM mobile station in MSC/VLRAction at arrival of mobile terminated call in MSC/VLR

SUBSTITUTE SHEET

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 93/00877

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: H04Q 7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: H04Q, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB, A, 2244409 (TELECOM SECURICOR CELLULAR RADIO LIMITED), 27 November 1991 (27.11.91), page 3, line 19 - page 4, line 9 --	1-4
A	WO, A1, 9119367 (MOTOROLA INC.), 12 December 1991 (12.12.91) --	1-4
A	EP, A2, 0102129 (MOTOROLA GMBH), 7 March 1984 (07.03.84) -----	1-4

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

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Information on patent family members

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International application No.
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Patent document cited in search report		Publication date	Patent family member(s)		Publication date
GB-A-	2244409	27/11/91	NONE		
WO-A1-	9119367	12/12/91	US-A-	5193216	09/03/93
EP-A2-	0102129	07/03/84	NONE		

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